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ARTICLE

Partial etiolation in light-grown sunflower (*Helianthus annuus*) cotyledons covered partly by the fruit wall (pericarp)

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We have shown that etiolation symptoms, prolamellar bodies (PLBs) and protochlorophyllide (Pchlide) accumulation occurs in the pericarp-covered regions of low light-grown (less than 20 μmol s^{-1} m^{-2}) sunflower (*Helianthus annuus* L.) cotyledons (Solymosi et al. 2007, Annals of Botany 99:857-867). We have observed that the pericarp of the achenes often remains attached to the cotyledons even 7 days after germination. The cells under the thick black or black and white striped pericarp develop under very low light conditions and have, therefore, reduced chlorophyll (Chl) biosynthesis and inhibited chloroplast differentiation. Large PLBs and bithylakoids are present in the plastids of the covered regions and the 77 K fluorescence emission spectra of these tissue regions show the presence of both photoactive and non-photoactive Pchlide spectral forms as well as a Chl band at 684 nm. Interestingly, the uncovered regions of the cotyledons (which have emerged from the fruit wall) also contained PLBs interconnected with grana, *i.e.* typical etio-chloroplasts were present in these tissues. In the 77 K fluorescence emission spectra of these uncovered cotyledon regions, the Chl bands characteristic for PSI and PSII of green leaves were dominating, and the relative contribution of the Pchlide bands was very low or, in some cases the Pchlide bands could not be detected in these uncovered zones. The transitional regions between the covered and uncovered regions showed a mixture of the characteristics of the covered and exposed sections. The photosynthetic activity has been monitored with fluorescence imaging, and the fluorescence kinetic parameters of the different regions have been recorded after the careful removal of the pericarp. Various, but significantly different values (smaller ones in the covered regions) of the photosynthetic activity parameters were found. The results of this work clearly demonstrate that the partial covering of the pericarp shades the cotyledon tissues effectively enough to provoke the appearance of etiolation phenomena, *i.e.* the permanent presence of flash-photoactive Pchlide complexes and PLBs (with or without Pchlide), which proves that etiolation symptoms may also appear under natural illumination conditions.